AMENDMENTS TO THE CLAIMS

The following listing of claims will replace all prior versions and listings of claims in the application.

LISTING OF CLAIMS

1. (Currently Amended) A fastening system comprising:

at least one workpiece having a first outside surface and a second outside surface substantially opposite the first outside surface; [[and]]

a fastener comprising:

(a) a distal end operably self-piercing the first outside surface and not the second outside surface;

(b) the distal end having a diverging shape when fully attached to the workpiece; [[and]]

(c) a body including a thread-like pattern; and

a machine operable to automatically insert the fastener into the workpiece, the machine comprising an electromagnetic and non-fluid powered actuator.

2. (Currently Amended) The fastening system of Claim 1 further comprising a stationary die always aligned with a punch of the machine, the die not having movable components ~~a machine operable to automatically insert the fastener into the workpiece, the machine comprising an electromagnetic and non-fluid powered actuator~~.

3. (Currently Amended) The fastening system of Claim 1 [[2]] further comprising a sensor operably sensing a fastener characteristic and a controller automatically varying a fastener insertion feature of the machine in response to the fastener characteristic sensed.

4. (Original) The fastening system of Claim 3 wherein the fastener characteristic is fastener size.

5. (Original) The fastening system of Claim 3 wherein the fastener characteristic is fastener insertion force.

6. (Original) The fastening system of Claim 3 wherein the fastener characteristic is fastener presence in the machine.

7. (Original) The fastening system of Claim 3 wherein the fastener characteristic is fastener location relative to the workpiece.

8. (Original) The fastening system of Claim 3 wherein the fastener characteristic is thickness of the workpiece.

9. (Original) The fastening system of Claim 3 wherein the fastener insertion feature is insertion speed, greater than zero.

10. (Original) The fastening system of Claim 3 wherein the fastener insertion feature is de-energization of the actuator.

11. (Currently Amended) The fastening system of Claim 1 [[2]] wherein the machine further comprises a punch and a transmission, the transmission operably converting rotary motion of the actuator to linear motion of the punch.

12. (Original) The fastening system of Claim 1 wherein the fastener is a self-piercing nut including a bore internally located in the body, and the thread is located in the bore.

13. (Original) The fastening system of Claim 12 further comprising a bolt enmeshed with the bore of the fastener.

14. (Original) The fastening system of Claim 1 wherein the at least one workpiece includes two sheet metal workpieces, with the first surface being a punch-side exterior surface of one of the workpieces and the second surface being a die-side surface of the other of the workpieces.

15. (Original) The fastening system of Claim 1 wherein the workpiece is an automotive body panel.

16. (Original) The fastening system of Claim 1 wherein the workpiece is a computer panel.

17. (Original) The fastening system of Claim 1 wherein the body of the fastener is a substantially cylindrical and elongated stud.

18. (Currently Amended) A joint comprising at least a pair of panels and an internally threaded clinch nut secured to at least the pair of the panels, the joint being leakproof, the nut including a substantially cylindrical internal surface between a leading end and a threaded segment prior to insertion in the panels.

19. (Currently Amended) The joint of Claim 18 wherein the leading end of the nut comprises a panel-piercing end.

20. (Original) The joint of Claim 19 wherein the nut comprises an enlarged body having a substantially circular-cylindrical, lateral outside surface.

21. (Currently Amended) The joint of Claim 18 wherein the leading end of the nut diverges ~~has a diverging end located~~ in at least one of the panels.

22. (Original) The joint of Claim 18 wherein the nut self-pierces through the punch-side one of the panels, the nut self-pierces partially in a die-side one

of the panels, and the nut does not project completely through the die-side one of the panels.

23. (Original) The joint of Claim 18 wherein at least one of the panels is a metal, automotive vehicle, body panel.

24. (Original) The joint of Claim 18 wherein at least one of the panels is part of a computer.

25. (Currently Amended) A joint comprising at least one workpiece and a clinch stud secured to the workpiece, an elongated shaft of the stud having an external pattern exposed from the workpiece, a diverging and self-piercing end of the stud being entirely encapsulated within the workpiece, the stud including substantially cylindrical internal surface between the self-piercing end and the shaft prior to insertion in the workpiece, and the external surface being substantially smooth and without flanges between the self-piercing end and the patterned shaft prior to insertion in the workpiece.

26. (Original) The joint of Claim 25 wherein the at least one workpiece includes at least two metallic panels.

27. (Original) The joint of Claim 26 wherein the stud self-pierces through the punch-side one of the panels, the stud self-pierces partially in a die-side

one of the panels, and the stud does not project completely through a die-side one of the panels.

28. (Original) The joint of Claim 27 wherein at least one of the panels is a metal, automotive vehicle, body panel.

29. (Original) The joint of Claim 25 wherein the external pattern is a spiral thread, and an end section of the stud adjacent the self-piercing end has a substantially cylindrical outside surface and a hollow cavity prior to installation.

30. (Original) A fastening system comprising:

a threaded fastener; and

a machine automatically operable to drive the fastener, the machine comprising:

(a) a C-frame;

(b) at least one transmission housing coupled to the C-frame;

(c) an electric motor;

(d) a transmission coupled to the motor, at least a portion of the transmission being located in the transmission housing; and

(e) a punch coupled to the transmission;

wherein the transmission operably transmits rotary motion of the motor to linear motion of the punch to operably push the fastener.

31. (Original) The fastening system of Claim 30 further comprising at least one sensor coupled to the machine and a controller connected to the machine, the sensor operably sensing a fastener characteristic and the controller automatically varying a fastener insertion feature of the machine in response to the fastener characteristic sensed.

32. (Original) The fastening system of Claim 31 wherein the fastener characteristic is fastener size.

33. (Original) The fastening system of Claim 31 wherein the fastener characteristic is fastener insertion force.

34. (Original) The fastening system of Claim 31 wherein the fastener characteristic is fastener presence in the machine.

35. (Original) The fastening system of Claim 31 wherein the fastener insertion feature is insertion speed, greater than zero.

36. (Original) The fastening system of Claim 30 further comprising a threaded member removably enmeshed with the fastener and a component secured to the fastener by the member.

37. (Original) The fastening system of Claim 36 wherein the component is an electrical connector.

38. (Original) The fastening system of Claim 36 wherein the component is a circuit board.

39. (Currently Amended) The fastening system of Claim 30 wherein the fastener is a self-piercing nut including a substantially cylindrical internal surface between a piercing end and a threaded segment prior to insertion in a workpiece.

40. (Currently Amended) The fastening system of Claim 30 wherein the fastener is a self-piercing stud including a substantially cylindrical internal surface between a piercing end and a threaded segment prior to insertion in a workpiece.

41. (Currently Amended) The fastening system of Claim 30 further comprising:

a die attached to the C-frame, the die always being substantially aligned with the punch, the fastener being prevented from directly contacting the die, all of the die being stationary during joint creation; and

a robotic arm coupled to at least one of the housing and the C-frame.

42. (Original) A fastening system comprising:

at least a pair of automotive vehicle panels;

a clinch nut comprising a cylindrically tapered end which self-pierces into the panels and diverges during installation, the nut further comprising an internally threaded body;

a non-fluid powered actuator;

a driver operably inserting the nut into the panels;

a transmission coupling the actuator to the driver;

a sensor operably sensing a fastening characteristic; and

a controller automatically controlling installation of the fastener into the panels in response to the sensed fastening characteristic.

43. (Original) The fastening system of Claim 42 wherein the fastener characteristic is fastener size.

44. (Original) The fastening system of Claim 42 wherein the fastener characteristic is fastener insertion force.

45. (Original) The fastening system of Claim 42 wherein the fastener characteristic is fastener location relative to the workpiece.

46. (Currently Amended) The fastening system of Claim 42 further comprising:

a housing containing at least portions of the transmission and driver;

a C-frame attached to the housing;

a die attached to the C-frame, the die always being substantially aligned with the driver, all of the die being stationary during joint creation; and

a robotic arm coupled to at least one of the housing and the C-frame.

47. (Original) The fastening system of Claim 42 wherein the actuator is an electric motor.

48. (Original) The fastening system of Claim 42 wherein the transmission operably converts rotary motion of the actuator into linear motion of the driver.

49. (Currently Amended) A fastener comprising:

an elongated shaft including an external thread-like pattern with an outside diameter; and

a workpiece-engaging section attached to the shaft at a proximal end and having a self-piercing distal end;

the workpiece-engaging section having a pre-installed outside diameter substantially the same as that of the shaft and without an undercut prior to installation.

50. (Original) The fastener of Claim 49 wherein the distal end outwardly diverges when installed.

51. (Original) The fastener of Claim 49 wherein the workpiece-engaging section directly extends from the shaft free of a transversely enlarged flange.

52. (Original) The fastener of Claim 49 wherein the workpiece-engaging section is substantially hollow within a pre-installed substantially cylindrical wall, a roof of the workpiece-engaging section adjacent the shaft is substantially flat and parallel to an exposed end of the shaft.

53. (Currently Amended) A method of attaching a threaded fastener to a panel using a punch and a die, the method comprising:

(a) advancing the punch;

(b) piercing the panel with the threaded fastener; [[and]]

(c) preventing the threaded fastener from directly contacting against the die; and

(d) keeping all of the die stationary during fastener insertion into the panel.

54. (Currently Amended) The method of Claim 53 further comprising piercing the fastener completely through the panel and only partially piercing the fastener through a second panel, while creating a die side surface of the panel with a protruding button formation free of an undercut.

55. (Original) The method of Claim 53 further comprising converting rotary motion of an electric motor to linear motion of the punch in order to linearly advance the threaded fastener.

56. (Original) The method of Claim 53 further comprising robotically moving the punch and die to a position adjacent the panel.

57. (Original) The method of Claim 53 further comprising attaching an electrical component to the threaded fastener.

58. (Original) The method of Claim 53 further comprising attaching a circuit board to the threaded fastener.

59. (Original) The method of Claim 53 wherein the fastener is a self-piercing nut, further comprising outwardly diverging an end of the fastener during installation, completely encapsulating the end of the fastener within the panel and creating a leakproof joint between the fastener and the panel.

60. (Original) A method of creating a joint between a threaded fastener, and at least one workpiece using an installation machine, the method comprising:

(a) rotating an electromagnetic member of the machine to create rotary motion;

(b) converting the rotary motion to linear motion for a second member of the machine;

(c) linearly advancing the threaded fastener toward the at least one workpiece; and

(d) self-piercing the at least one workpiece with the threaded fastener.

61. (Original) The method of Claim 60 further comprising at least one sensor coupled to the machine and a controller connected to the machine, the sensor operably sensing a fastener characteristic and the controller automatically varying a fastener insertion feature of the machine in response to the fastener characteristic sensed.

62. (Original) The method of Claim 61 wherein the fastener characteristic is fastener insertion force.

63. (Original) The method of Claim 61 wherein he fastener insertion feature is insertion speed, greater than zero.

64. (Original) The method of Claim 60 further comprising attaching an electrical component to the threaded fastener.

65. (Original) The method of Claim 60 further comprising attaching a circuit board to the threaded fastener.

66. (Original) The method of Claim 60 wherein the fastener is a self-piercing nut, further comprising outwardly diverging an end of the fastener during installation, completely encapsulating the end of the fastener within the panel and creating a leakproof joint between the fastener and the panel.

67. (Original) The method of 60 further comprising preventing the threaded fastener from completely penetrating through a die-side surface of the at least one workpiece.

68. (Original) The method of Claim 60 further comprising removably engaging a second threaded member with a threaded portion of the threaded fastener to secure a component to the workpiece.

69. (Original) The method of Claim 60 further comprising fastening together at least two of the workpieces with a self-piercing segment of the threaded fastener.